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# PATENT SPECIFICATION

DRAWINGS ATTACHED

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935,490



935,490

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International Classification:—A61b.

## COMPLETE SPECIFICATION

### An Instrument for Suturing Blood Vessels and Nerves

We, RESEARCH INSTITUTE OF EXPERIMENTAL SURGICAL APPARATUS AND INSTRUMENTS, a Soviet Corporation, of 6 Fabrichnaya Linie, Moscow, Union of Soviet Socialist Republics, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention consists in an instrument for suturing blood vessels and nerves. The instrument comprises split annular staple anvils each of which can be placed around the ends of an organ to be sutured, split annular staple holders each of which can be held so as to co-operate with one of the staple anvils at least one anvil and at least one staple holder having flanges on to which the ends of the blood vessels can be folded as cuffs. Moreover at least one anvil and at least one staple holder are adapted for forming bulges on the ends of nerves to be sutured. The instrument also comprises two holders for respectively holding one of the staple anvils and one of the staple holders, and means for driving a ring of staples out of the staple holder, through cuffs or bulges on the organs to be sutured and against the anvil.

Further details of the instrument are now given with reference to the accompanying drawings.

Figure 1 is a longitudinal section of a complete end-to-end suture between blood vessels.

Figure 2 is a surface view of an end-to-side suture between blood vessels.

Figure 3 is a longitudinal section of a nerve suture.

Figures 4 and 5 are two views (partly in sections) of the holder for the staple holder.

[Price 4s. 6d.]

Figure 6 is a section on the lines VI—VI of figure 4.

Figure 7 is a section on the line VII—VII of figure 5.

Figures 8 and 9 show the holder for the anvil.

Figure 10 is a section on the line X—X of figure 9.

Figures 11 to 15 illustrate the construction of the staple holder.

Figure 16 shows the instrument set up for making end-to-end sutures between blood vessels.

Figure 17 is a section on the line XVII—XVII of figure 16.

Figure 18 shows the instrument set up for making end-to-side sutures between blood vessels.

Figure 19 is a section showing the making of an end-to-end suture between vessels.

Figures 20 and 21 show the instrument with haemostatic clamps attached ready for making an end-to-end suture between blood vessels.

Figure 22 shows the placing of a nerve suture.

Figures 23 and 24 show the instrument set up for making nerve sutures.

Figure 25 is a section showing the placing of an end-to-side suture.

Figures 26 and 27 show the instrument set up for making end-to-side sutures.

As shown in figure 1, an end-to-end blood vessel suture, when finished is made up of a pair of flanges FL (one of which is turned back as a cuff) joined by metal staples ST bent in to B-shapes.

The instrument includes a pair of holders for split annular staple holder and the split annular staple anvil respectively. The holder for the staple holder (figures 4 to 7) is made

up of two bars B1 and B2 with semi-circular ends SE for encompassing the staple holder. The bars are aligned by pins P and P<sup>1</sup> and, as shown in figure 7, the end of pin P<sup>1</sup> has a recess by which it is locked in place by a sliding bolt SB with a handle BH. The holders for the anvil and the staple holder are used for making all three types of sutures shown in figures 1—3.

Two removable operating levers OL have their right-hand ends (figures 4 and 5) supported on pivot balls PB while their left hand ends LE, which are bent round at right angles project through holes in the semi-circular ends SE. On turning levers OL these ends LE can be moved from the positions shown in broken lines in figure 6 to those shown in full lines and *vice-versa*. The ends SE of the bars B1 and B2 have internal grooves for receiving the staple holder.

The holder for the staple anvil shown in figures 8—10 is similar to the holder just described. Its two component bars B3 and B4 with semi-circular ends SE<sup>1</sup> are aligned by a pin P near the ends SE<sup>1</sup> and by a lug L fitting into slot in the right hand end of bar B3. The bars are held together by a sliding bolt, SB with handle BH, co-operating with a second pin P<sup>1</sup>.

As shown in figures 11—13a the staple holder SH is made in two halves the lower half being shown in broken lines in figures 11 and 12. Each half has staple slots SS into which the staples ST are placed with forceps. The staples are driven out by a staple punch SP which has fingers F (figure 14) projecting into the slots SS. It also has socket SO for receiving the bent round ends LE of levers OL. As shown in figures 13 and 13a the parts of the staples ST connecting the limbs of the staples are curved to correspond with the curvature of the slots SS. The staple holder has a flange FL<sup>1</sup> for fitting in the internal groove SR<sup>1</sup> in the bar ends SE.

The instrument is supplied with a set of staple holders and anvils with various bores (2.0 to 8 mm for making end-to-end sutures between blood vessels, 3.5—8 mm for making end-to-side sutures between vessels 2.5 to 5 mm for those for nerve sutures).

For making end-to-end sutures, the two holders with the annular staple anvil and the annular staple holder are fitted together as shown in figures 16 and 17. They are aligned by guide pin GP and guide lug GL and the distance *d* between the staple holder and the anvil can be varied by moving rod R in the direction of its length using handle R<sup>1</sup>. This rod has conveying cam grooves CG fitting over follower ridges FR on the holders so that when the rod is moved these pins FR are moved together or further apart. The distance *d* is shown by an index I on a scale

SC. The rod R is held in place on one holder by a retaining stud RS.

In figure 16 the levers OL are omitted to simplify the drawing. The split annular staple anvil SA has recesses SR into which the staples are driven in order to bend them into the required B-shape.

The instrument can be put together as shown in figure 18 for making end-to-side sutures. Here the grooves CG in a different rod R engage different pins FR. Pin PP serves as a pivot. Moreover staple anvil SA extends through the staple holder. As shown in figure 19 for making an end-to-end blood vessel suture the vessels V are closed with haemostatic clamps HC. The ends of the vessels are folded back in the manner of cuffs over the flanges forming the adjacent parts of the staple holder (on the left of figure 19) and the staple anvil (on the right). The folded back parts are held in position by holding plates HP (whose construction is described below). The two halves of the staple punch are then moved to the left using levers OL so as to cause the ring of staples ST, in the slots SS to pierce the vessels V and be bent into B-shapes in the recesses SR in the staple anvil. Plates HP are then released and the bars B1, B2, B3 and B4 are separated so as to release the staple holder and the staple anvil which are then each separated and from the vessels ends. The clamps HC are removed last of all. The suture will then appear as shown in figure 1.

Figures 20 and 21 show the instrument with the detachable haemostatic clamps HC locked in position on each side of it. The jaws CJ of the clamps are carried on metal strips MS running along the instrument. The lower strips are connected with tightening screws AS which press against loop-shaped springs LS abutting against the upper strips MS of each clamp. The springs therefore urge jaws CJ together and the gripping force of the jaws can be adjusted using screws AS. Near the jaws the lower strips MS carry guide studs GS ensuring that the strips are not pushed apart.

The two pairs of plates HP are carried on two pairs of rods SR<sup>11</sup> with handles RH.

When set up for use as in nerve suturing instruments as shown in figures 22—24 we provide the instrument with nerve clamps NC on each side of the staple holder SH and the staple anvil SA mounted on each side of the instrument. When the nerves have been placed in the staple holder and anvil, the bushes BU are moved inwards so as to force the ends of the nerves together with the result that their epineuria form annular bulges between the staples and staple-bending recesses SR. The staple punch SP can then be driven home.

As shown in figures 23 and 24, the instrument for nerve suturing differs from that

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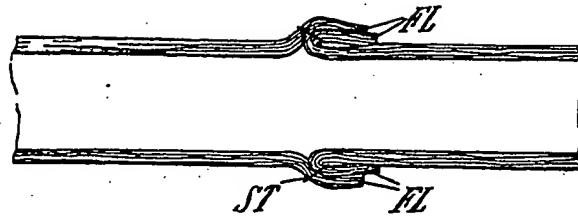


Fig. 1.

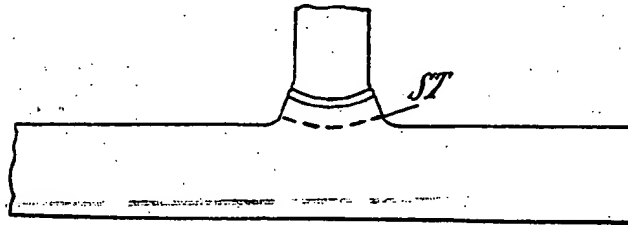


Fig. 2.

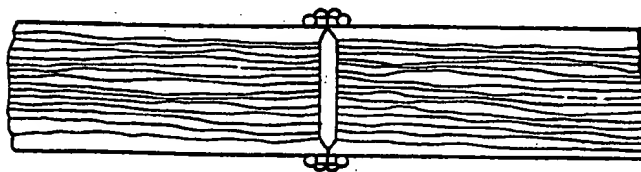


Fig. 3.

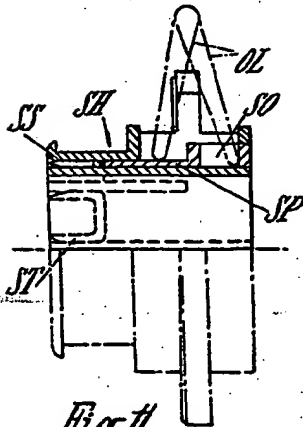


Fig. 11.

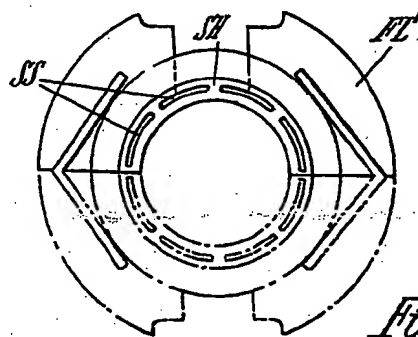


Fig. 12.

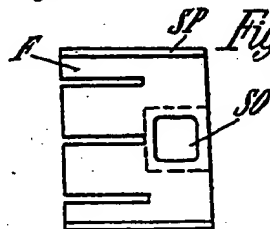


Fig. 14.



Fig. 15.



Fig. 13.

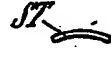
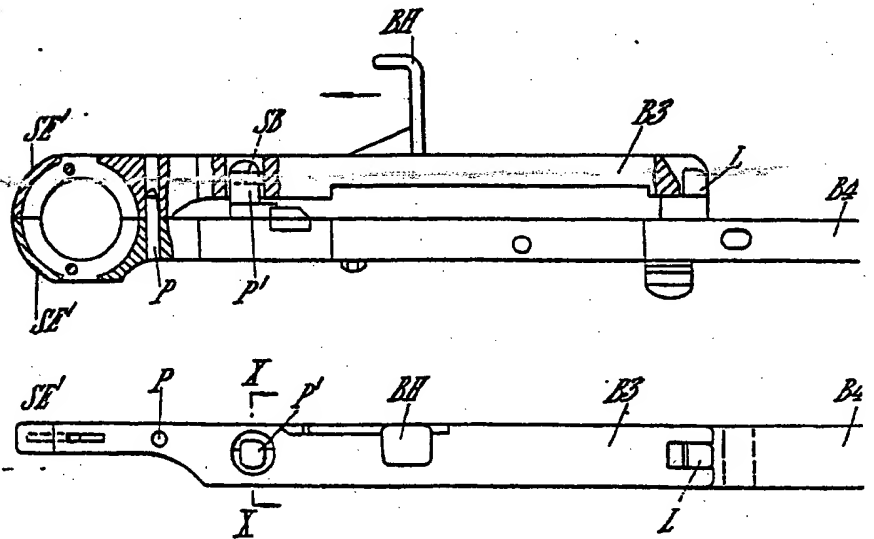
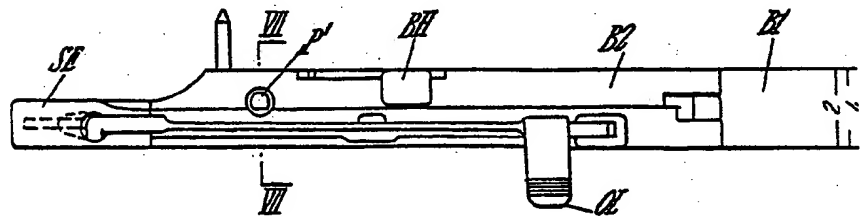
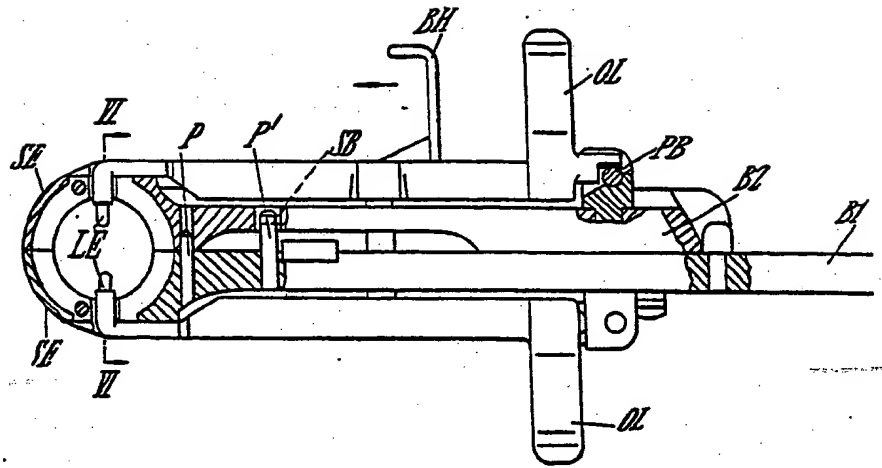


Fig. 13a.



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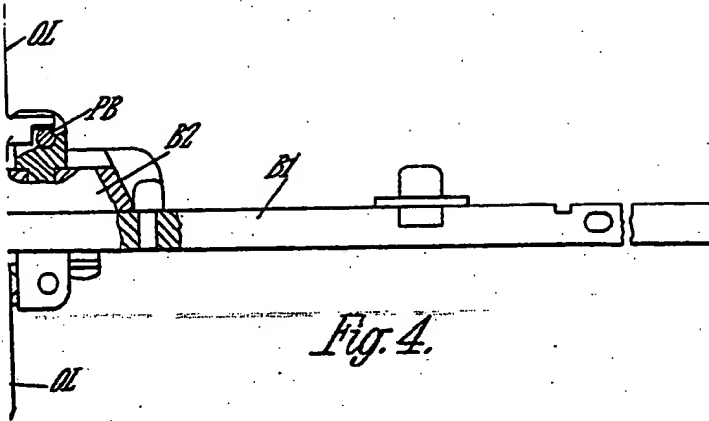


Fig. 4.



Fig. 6.

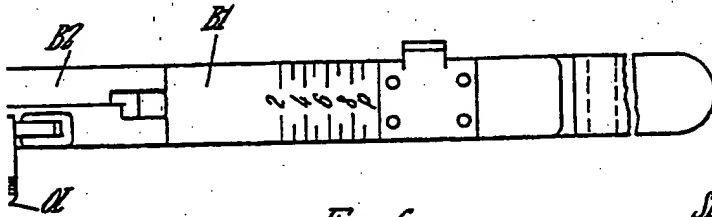


Fig. 5.

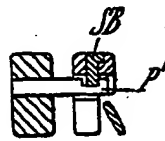


Fig. 7.

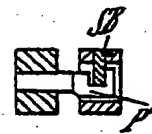


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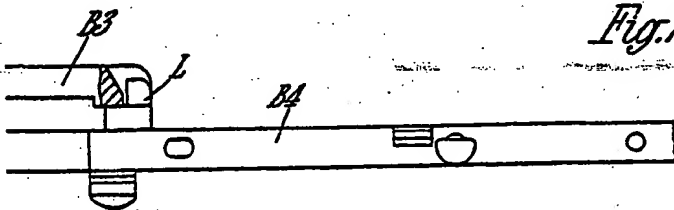


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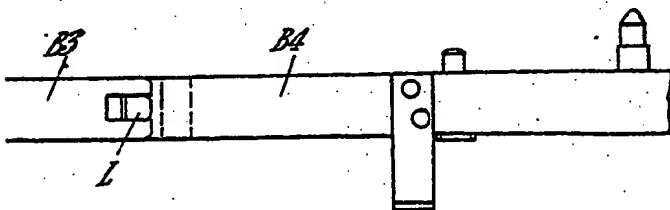


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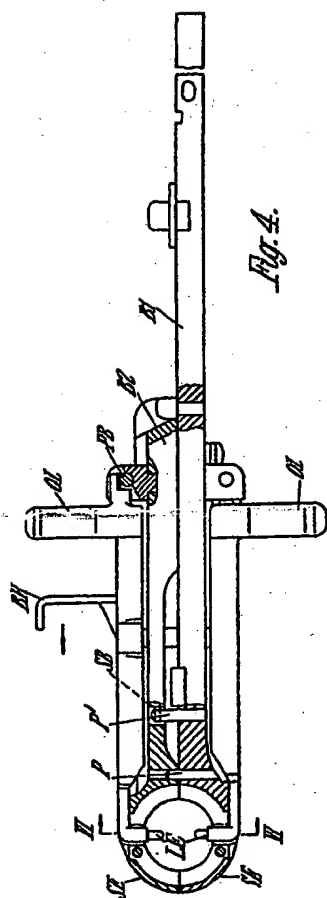


Fig. 4.

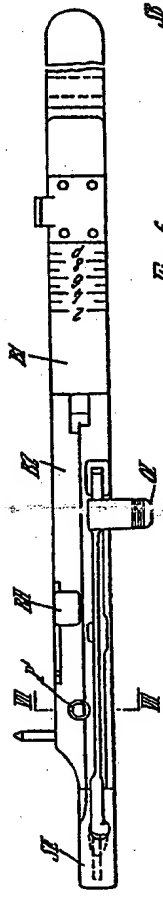
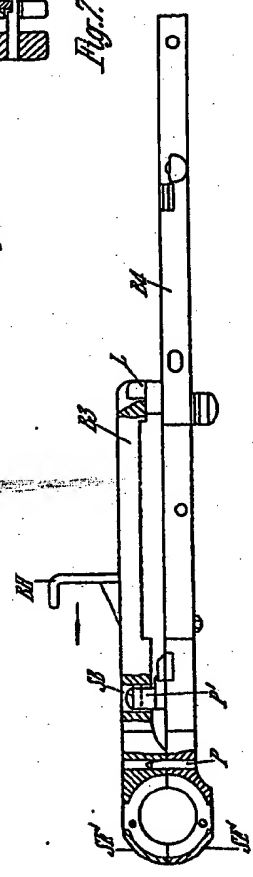
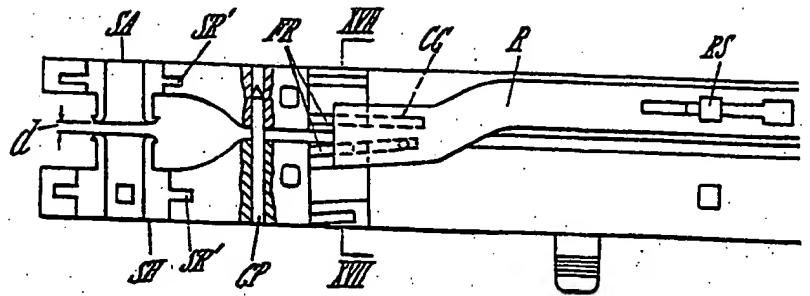


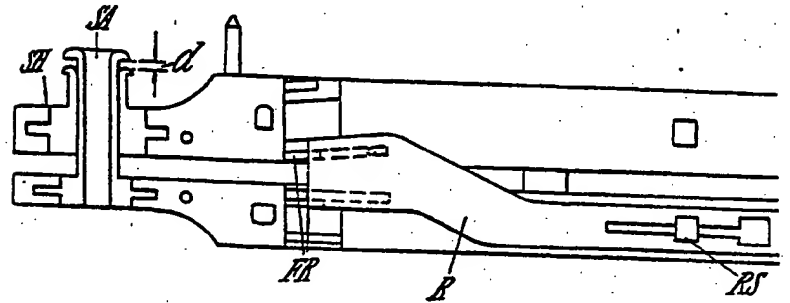
Fig. 5.



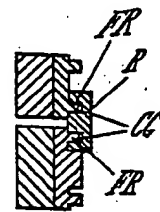




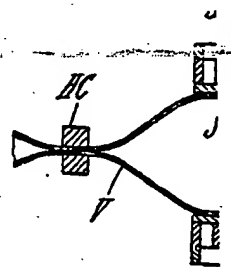
*Fig. 16.*



*Fig. 18.*



*Fig. 17.*

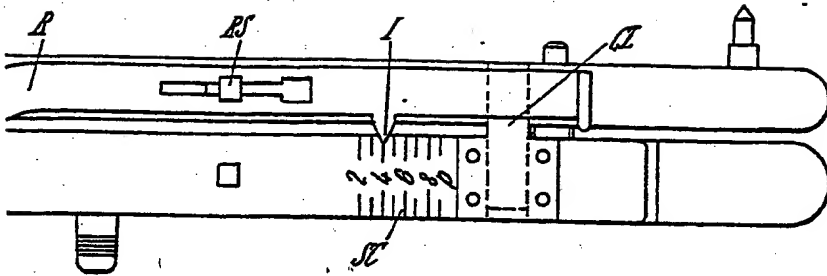


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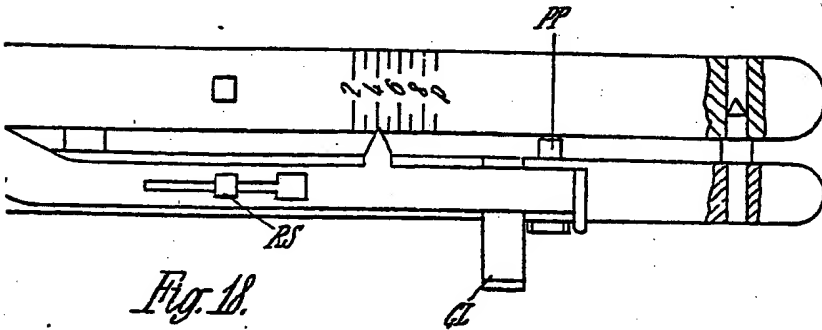
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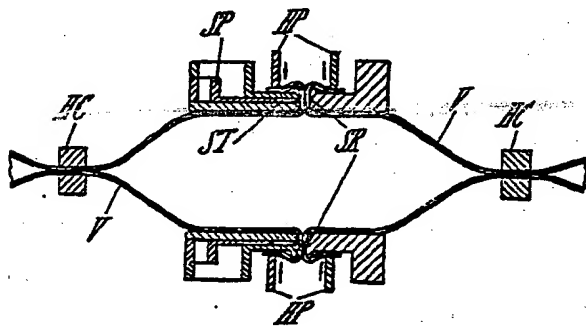
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*Fig. 16.*



*Fig. 18.*



*Fig. 19.*

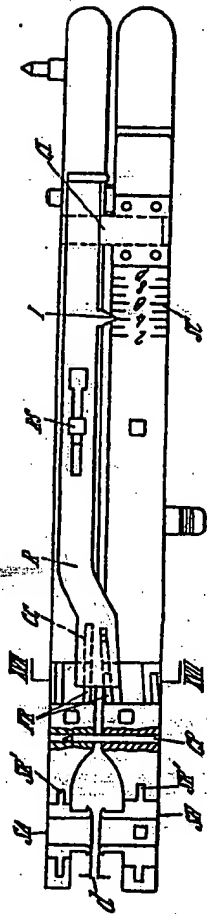


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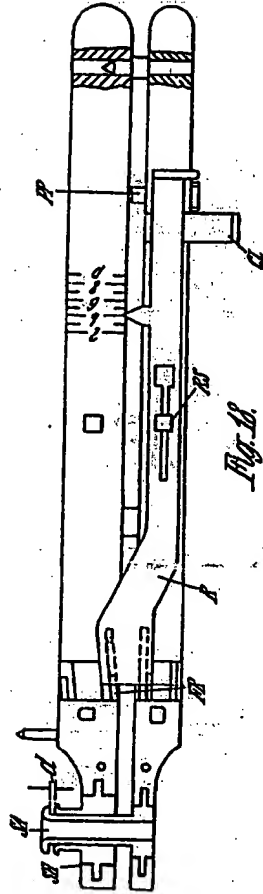


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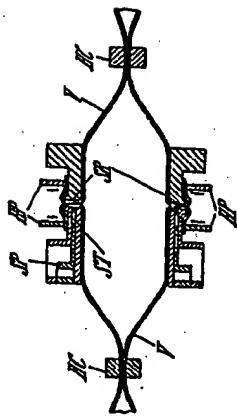
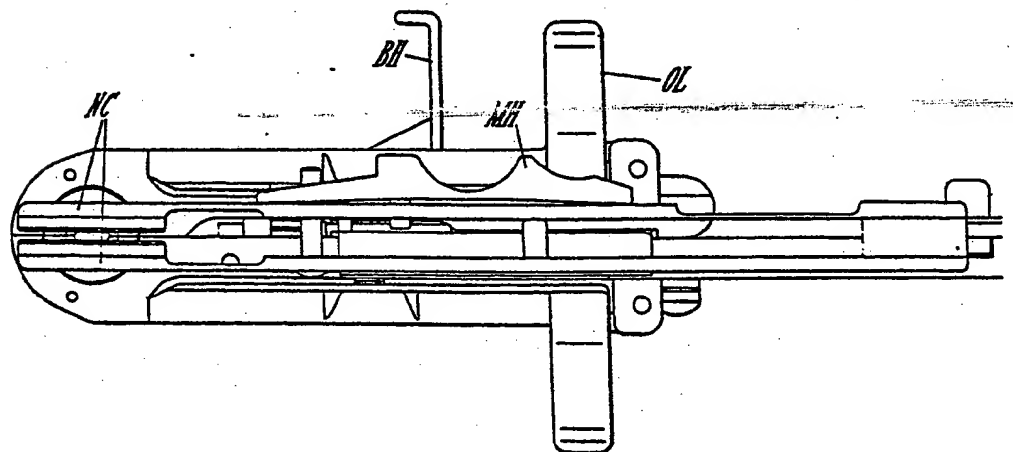
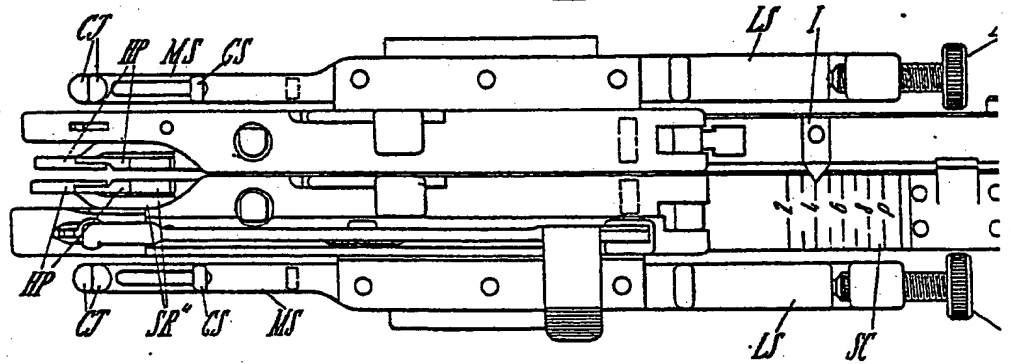
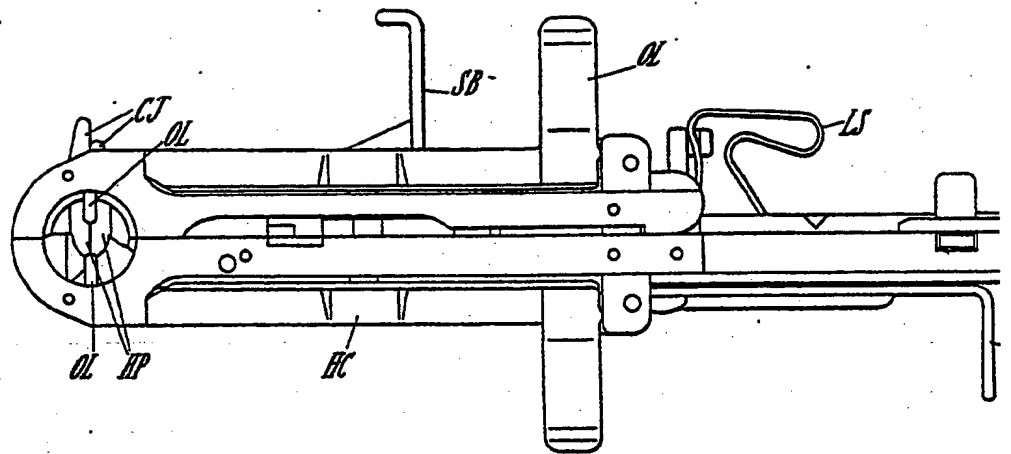
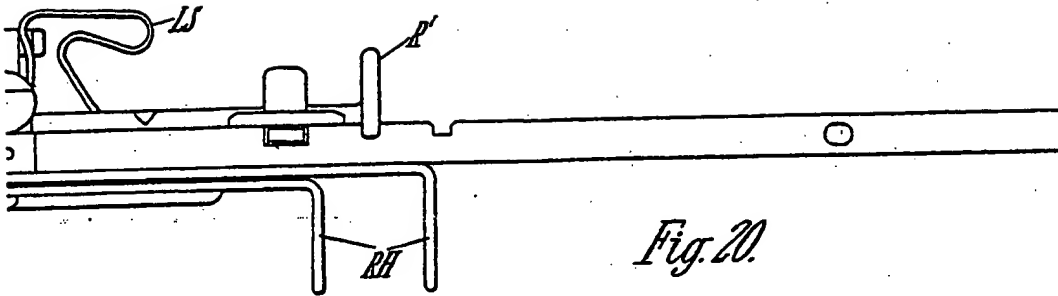


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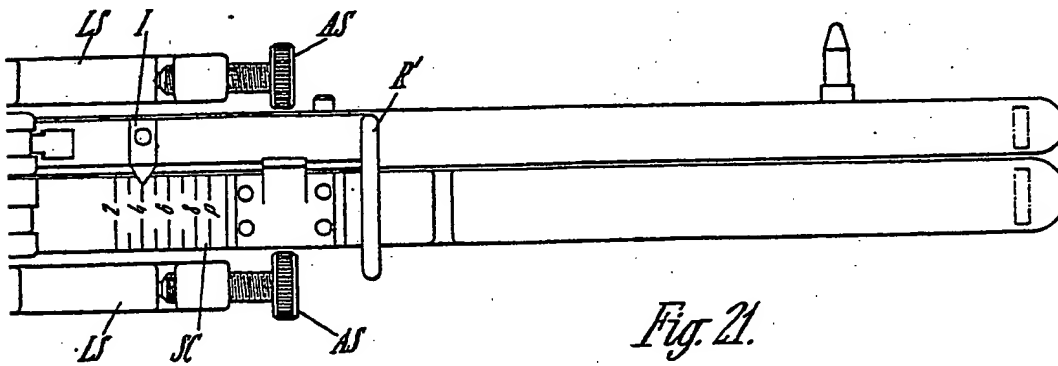


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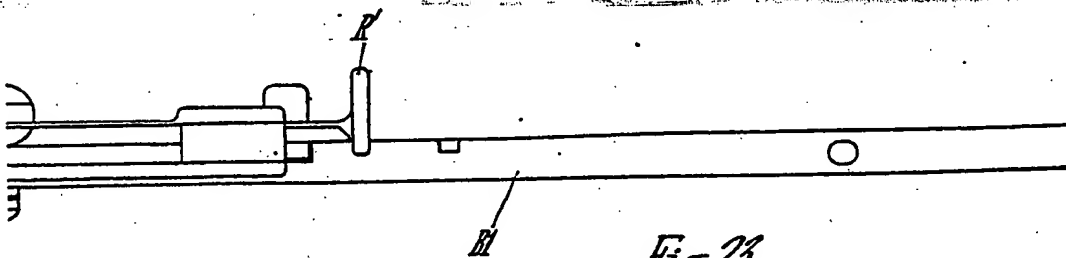




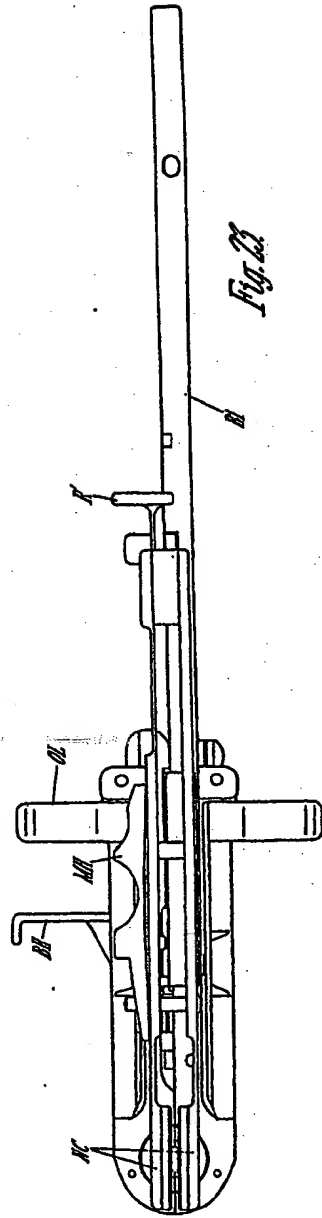
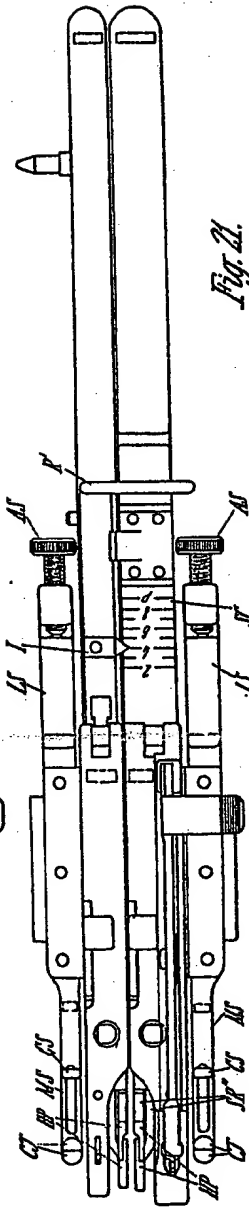
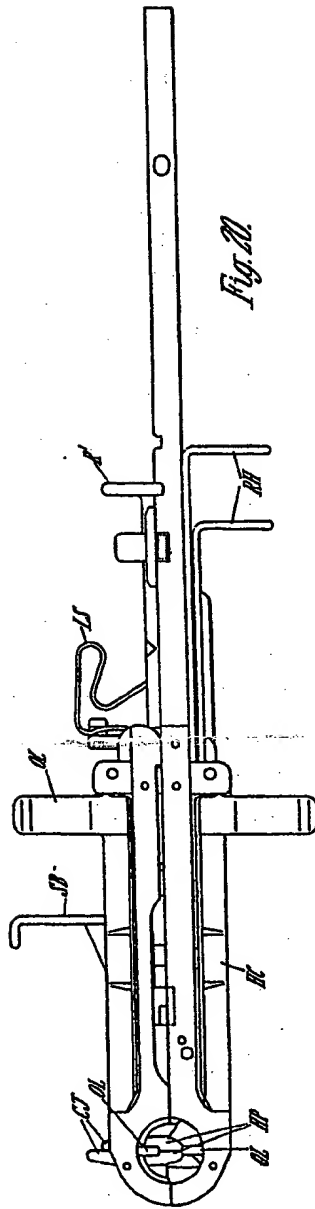
*Fig. 20.*

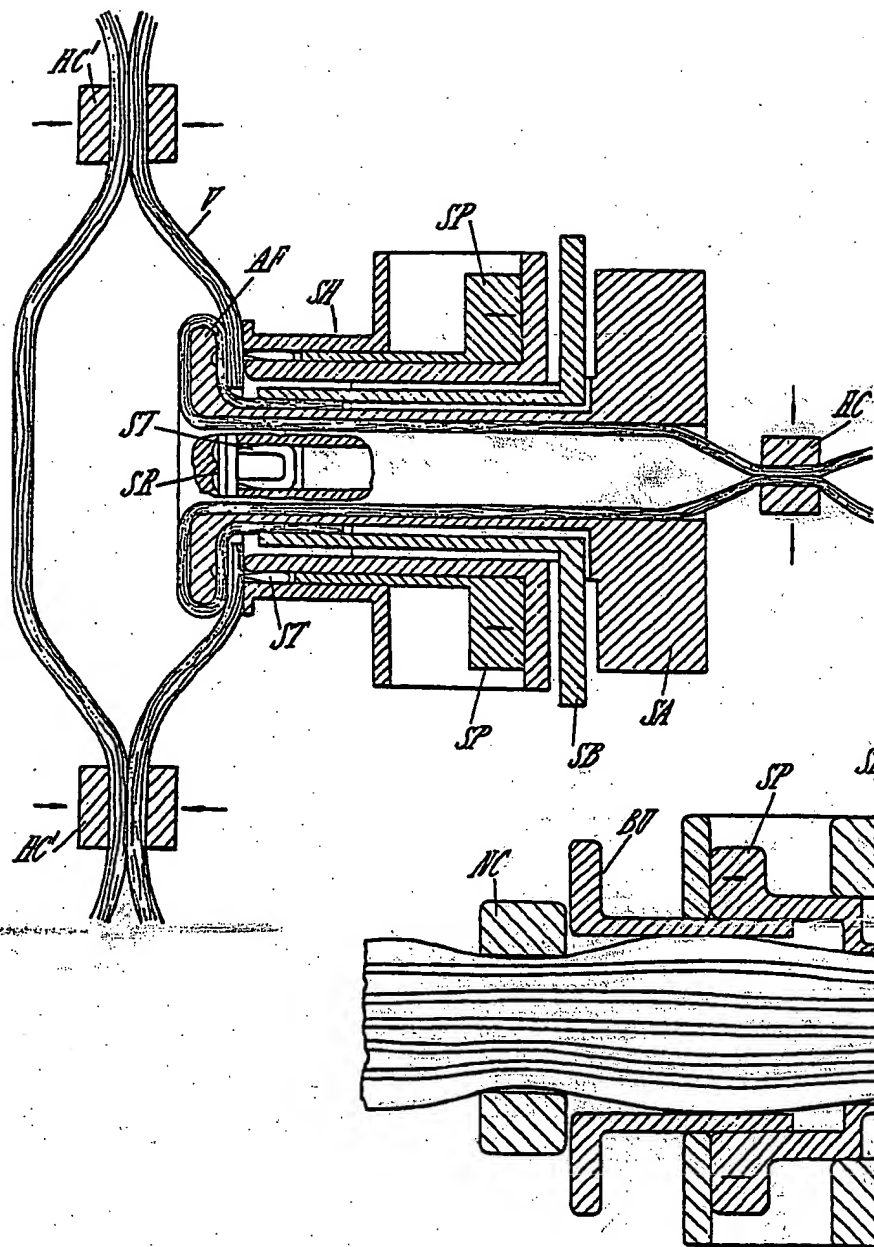


*Fig. 21.*



*Fig. 22.*

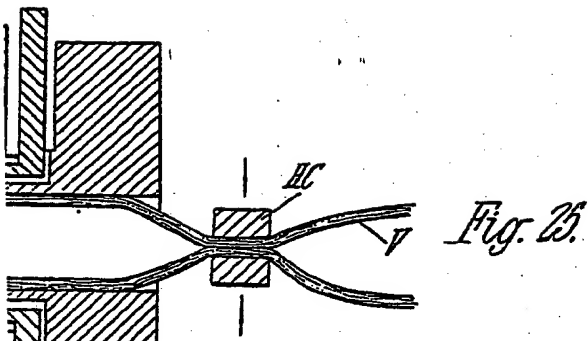




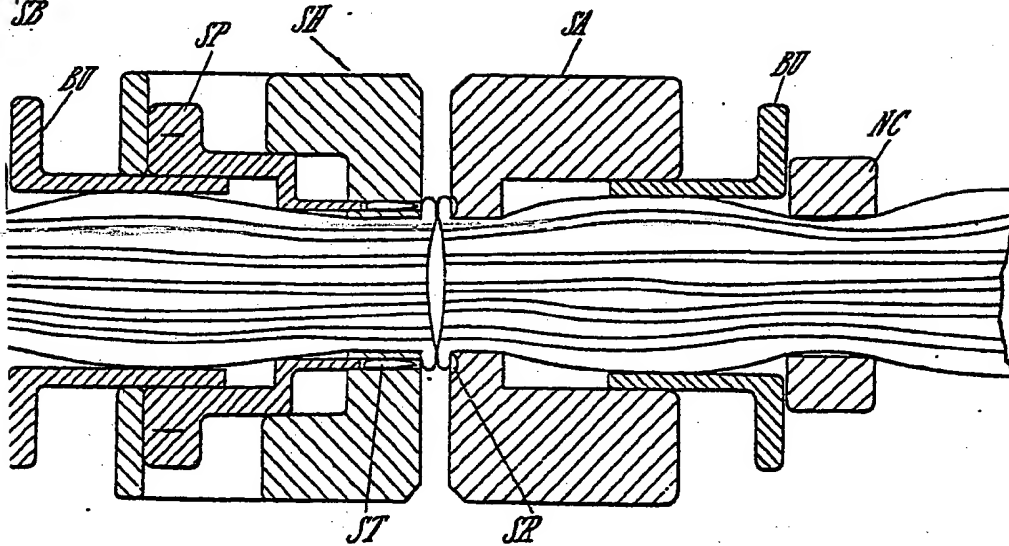
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*Fig. 22.*





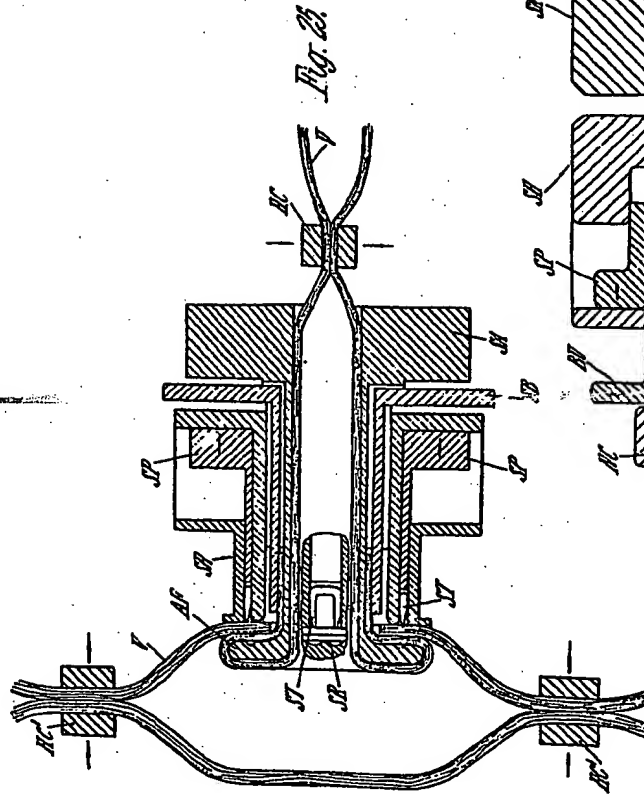


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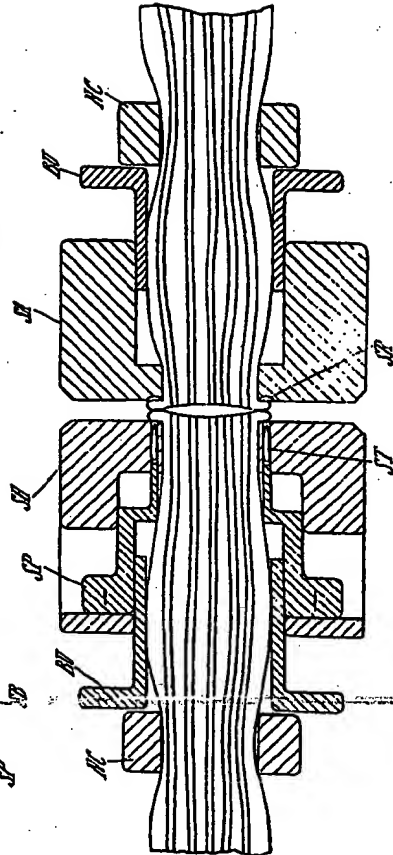
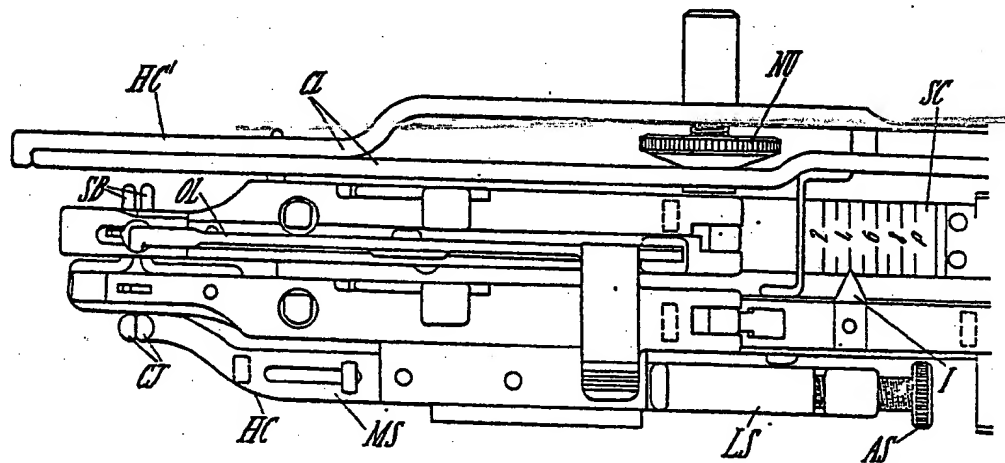
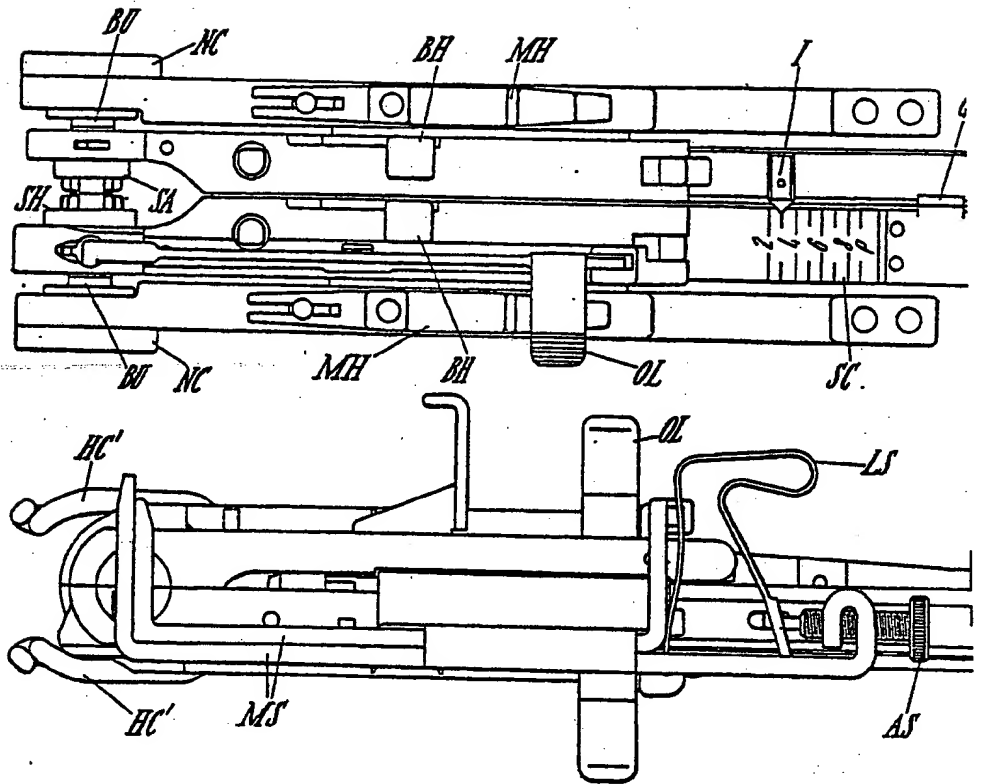


Fig. 24

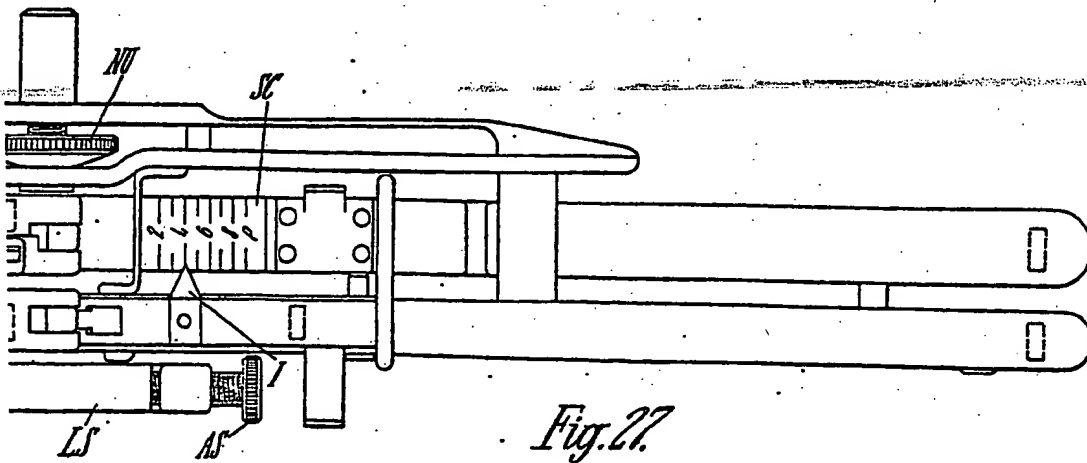
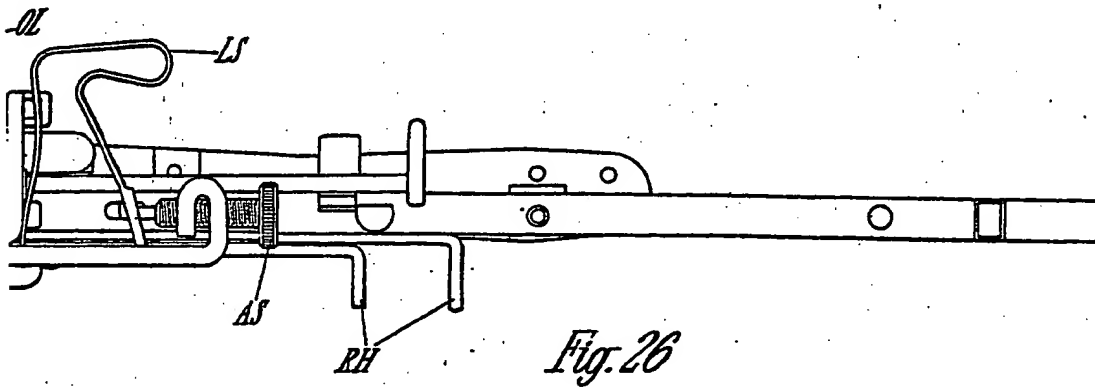
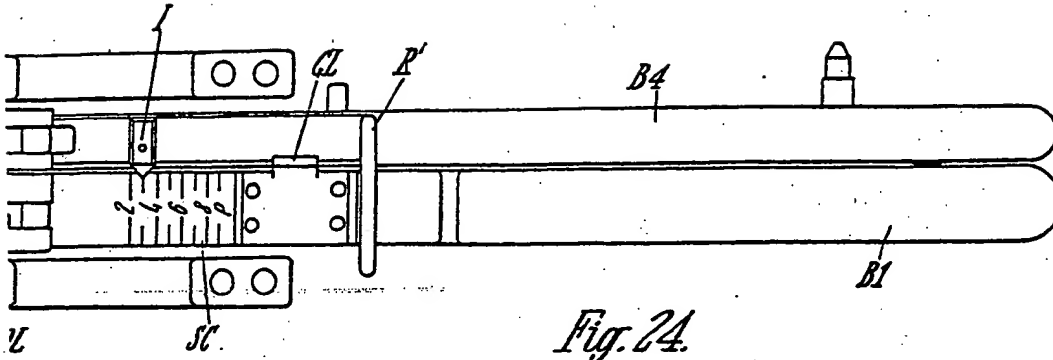


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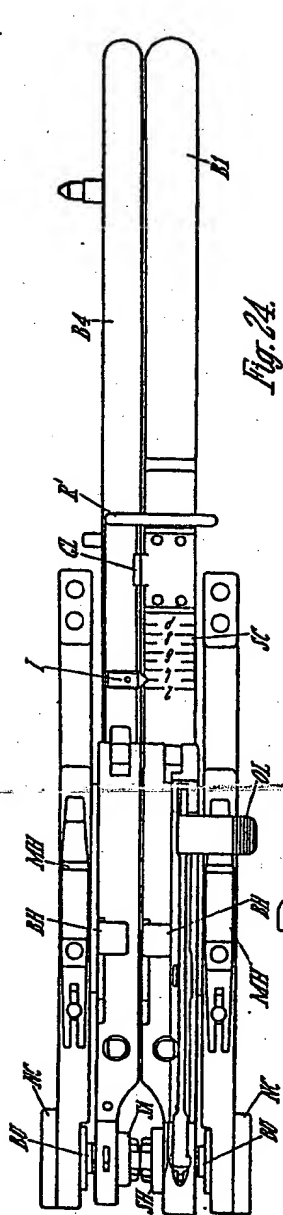


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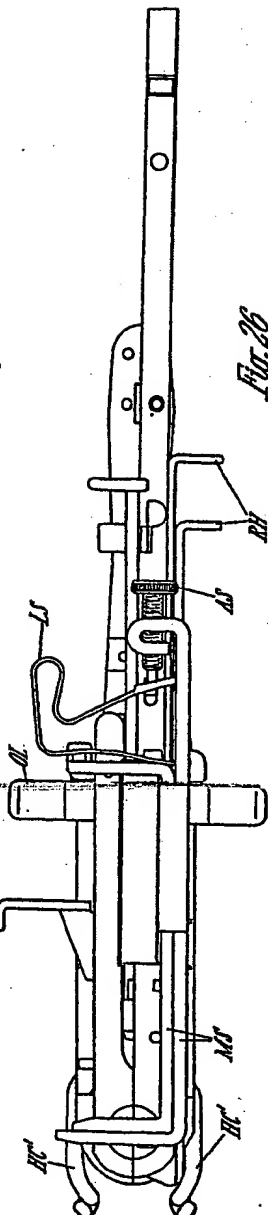


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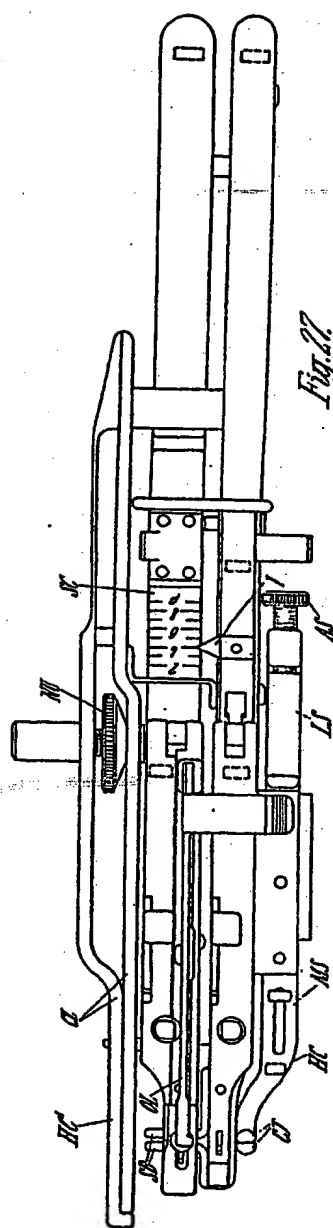


Fig. 26.